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Early academic skills and childhood experiences across the urban–rural continuum

Portia Miller*, Elizabeth Votruba-Drzal

University of Pittsburgh, Pittsburgh, PA, United States

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ABSTRACT

The urban–rural continuum provides unique contexts for development. Differences in access to resources and childrearing norms and practices in urban, suburban, and rural areas may be linked to disparities in early achievement. Yet, few studies examine associations between urbanicity and children's early academic skills. Using nationally representative data from the Early Childhood Longitudinal Study, Birth Cohort ($N \approx 6050$) this study examined differences in academic skills at kindergarten entry across large urban, small urban, suburban and rural areas. Additionally, it considered whether home environments and child care experiences explained disparities in early achievement. Results showed that children in large urban and rural areas entered kindergarten with less advanced academic skills than children in small urban areas and suburbs. Lower achievement for rural children was partly explained by less advantageous home environments and increased use of home-based, rather than center-based, preschool. Parents living in large urban areas had less knowledge of child development, which helped explain their children's lower achievement.

1. Introduction

Large urban, small urban, suburban, and rural areas provide unique contexts for child development. While specific definitions vary across research, on a conceptual level, these communities differ on three key dimensions: population density, with urban areas being the most dense; proximity to an urban core, with suburbs being more proximal than rural areas; and the commuting behavior of its residents, with increased commuting in suburbs as compared to urban and rural areas (Champion & Hugo, 2004). Practically, these characteristics lead to differences across the urban–rural continuum in resource accessibility, economic characteristics, and collective human, social, and cultural capital, all of which may have significant implications for children and families (Evans, 2006; Vernon-Feagans, Gallagher, & Kainz, 2008). Yet, developmental research has rarely explored associations between urbanicity and children's development. Limited research suggests that urbanicity may be linked to the development of early academic skills, with rural children lagging behind their more urban peers in kindergarten achievement (Lee & Burkham, 2002). It remains unclear, however, how differences in the early experiences of children living in communities spanning the urban–rural continuum help to explain these disparities in academic skills.

This study aims to strengthen our understanding of how urbanicity relates to academic skills development in early childhood. Using nationally representative data from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), it examines differences in early reading and math skills of children residing in large urban cities, small urban areas, suburbs, and rural areas. Furthermore, it advances the developmental literature by considering whether differences in home environments and early childhood education (ECE) explain disparities in academic skills at the start of kindergarten. Identifying how contexts spanning the urban–rural continuum contribute to differences in children's early experiences and academic skills is important since children who enter kindergarten with more advanced literacy and numeracy skills have an increased likelihood of future academic success (Duncan et al., 2007).

1.1. Urbanicity as a context for child development

To understand urbanicity's relationship with early academic skills acquisition, this study is guided by a bioecological theory of development. According to the bioecological model, variation in developmental outcomes must be understood in relation to the entire ecological system in which growth occurs (Bronfenbrenner & Morris, 1998). Children's environmental contexts, individual

* Corresponding author at: Department of Psychology, University of Pittsburgh, 4017 Sennott Square, 210 South Bouquet Street, Pittsburgh, PA 15260, United States. Tel.: +1 412 624 1216.
E-mail address: plm11@pitt.edu (P. Miller).

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characteristics, history, and developmental stage interact to produce the proximal processes that drive human development (Bronfenbrenner & Ceci, 1994). Thus, by influencing proximal interactions in a child's life, distal contexts shape development (Huston, McLoyd, & Garcia Coll, 1997). This study focuses on how one dimension of children's more distal environment, urbanicity, relates to children's home environments and child care experiences, which we expect will be associated with early academic skills development.

Despite the importance of understanding the influence of distal factors on child development, few studies have considered how urbanicity shapes the development of early academic skills. There is significant variability in population, economic circumstances, resources, and cultural capital along the urban–rural continuum. For instance, rural areas are sparsely populated and often have limited access to developmentally salient resources, like health care, libraries, and child care (Evans, 2003; Vernon-Feagans et al., 2008). Furthermore, over the last few decades, many of their talented young people have migrated to urban and suburban areas as high-quality jobs in rural communities have disappeared (Vernon-Feagans et al., 2008). The dispersion of people, scarcity of services, and recent departure of human capital may leave rural families without access to important resources and cultural capital, which may make it harder for rural parents to provide children with enriching experiences and interactions. This may, however, be tempered by positive aspects of rural residence, such as increased home-ownership and accessibility of nature and green spaces (George & Holden, 2000; Wells & Evans, 2003). In large cities, on the other hand, access to developmentally salient resources may not be problematic, but these locales are often plagued with a lack of green spaces, crime, overcrowding, and pollution, which could negatively impact parenting and early development (Evans, 2006; Linares et al., 2001; Wachs & Camli, 1991). While little empirical evidence exists regarding suburbs and small towns as contexts for early development, these places may offer the best of both worlds—wide availability of resources (or proximity to resources in the case of suburbs) without the chaos of inner-cities or isolation of rural areas. These differences in developmental contexts across the urban–rural continuum may result in variation in the development of early academic skills.

1.2. Proximal processes linking urbanicity to early achievement

1.2.1. Home environment

Differences in children's home environments across large cities, small cities, suburbs, and rural areas may result in urbanicity-related differences in early academic skills. In particular, cognitive stimulation in the home, parenting quality, and parental childrearing beliefs and academic expectations appear to be important predictors of early achievement. Cognitive stimulation in the home, which includes the provision of educational interactions (e.g. book reading and teaching numbers and letters), activities (e.g. trips to the museum and zoo) and materials (e.g. toys and books), enhances language, literacy, and numeracy skills (Melhuish et al., 2008; Son & Morrison, 2010; Yeung, Linver, & Brooks-Gunn, 2002). Similarly, high quality parenting in early childhood, which is characterized by high levels of warmth, consistency, and responsiveness and infrequent displays of harsh, detached, inconsistent or intrusive parenting, promotes early cognitive and academic development (Arend, Gove, & Sroufe, 1979; Bus & van IJzendoorn, 1988; Lugo-Gil & Tamis-LeMonda, 2008). Lastly, parents' beliefs and expectations regarding childrearing and education are related to early academic skills. For instance, parents' knowledge of child development predicts children's early cognitive growth (Benasich & Brooks-Gunn, 1996; Glick, Bates, & Yabiku, 2009). In addition, the expectations parents have regarding their children's academic achievement have been associated with subsequent achievement (Davis-Kean, 2005; Halle, Kurtz-Costes, & Mahoney, 1997).

Prior research provides little comparative evidence about urbanicity-related differences in children's home environments. Rural children may experience less cognitive stimulation than their urban and suburban peers due to their lack of proximity and access to educational activities and materials, such as libraries, museums, and cultural activities. Libraries, for example, are less accessible in rural communities, which may reduce access to developmentally appropriate reading materials in rural homes (Vernon-Feagans et al., 2008). In addition, economic changes in rural areas have resulted in the proliferation of lower paying jobs that include irregular work hours, low wages, and fewer benefits (Weber, Duncan, & Whitener, 2002). This has led to an increase in multiple jobs and non-standard work hours for rural parents in comparison to more urban parents, which, coupled with the geographic dispersion and transportation barriers attendant in rural areas, may decrease the amount of time with which rural parents have to engage in stimulating activities with their children (Vernon-Feagans et al., 2008). Conversely, if children living in more urban areas are closer to a variety of enriching activities, the frequency with which urban and suburban children are exposed to stimulating experiences may be greater, thereby raising the quality of their early learning environments.

Additionally, differences in childrearing practices and beliefs between rural and more urban parents may lead to variation in home environments across the urban–rural continuum. The limited research comparing rural versus urban parenting styles has generally found rural parents to be less emotionally supportive, more intrusive, and harsher than more urban parents (Bornstein et al., 2008; Pinderhughes, Nix, Foster, & Hughes, 2001). Also, rural families tend to place less emphasis on children's achievement than do more urban families (Lampard, Voigt, & Bornstein, 2000; Mussen & Maldonado Beytagh, 1969; but see Coleman, Ganong, Clark, & Madsen, 1989). Along those lines, compared to more urban parents, rural parents tend to hold lower expectations for their children's educational attainment (McCracken & Barcinas, 1991). Rural parents have also been found to invest less in educational materials and cultural experiences and display less involvement in their children's academic experience than do more urban parents (Roscigno, Tomaskovic-Devey, & Crowley, 2006). Differences in childrearing knowledge have also been observed; urban/suburban parents tend to believe they have more influence over their children's development and are more knowledgeable regarding child development (Bornstein et al., 2008; Lampard et al., 2000). While the bulk of research suggests that parenting in urban/suburban areas is most beneficial to child development, there may be environmental factors unique to residing in large, population-dense central cities that increase parental distress and, subsequently, compromise parenting quality, such as overcrowding, high traffic density, crime, and lower neighborhood cohesion (Cutrona, Wallace, & Wesner, 2006; Linares et al., 2001; Sampson, 1991; Wachs & Camli, 1991).

1.2.2. Early childhood education

A second pathway by which urbanicity may relate to early achievement is via children's ECE experiences. In particular, formal, center-based ECE attendance has been shown to enhance academic skills compared to parental and home-based care (Loeb, Fuller, Kagan, & Carrol, 2004; Magnuson, Meyers, Ruhm, & Waldfogel, 2004; NICHD ECCRN & Duncan, 2003). Urbanicity may impact families' use of formal center care if such settings are limited in less urbanized areas. Indeed, center-based ECE settings are generally less available in rural areas (Gordon & Chase-Lansdale, 2001; Kisker, Hofferth, Phillips, & Farquhar, 1991). Longer commutes and non-standard work schedules may also limit rural families' ability to use center-based care, which largely

operates during normal business hours (Han, 2004; Presser, 1989). Further, in comparison to urban areas, rural center-based ECE is disproportionately funded by Head Start or local governments and, hence, provides subsidized care reserved for low-income families (Beach, 1995). This may leave many non-poor rural families without access to center care. Indeed, rural families use more informal care and less center-based ECE than their urban and suburban counterparts (Atkinson, 1994; Grace et al., 2006; Kisker et al., 1991), though research has not uncovered whether these patterns are due to center care availability constraints or preferences for informal care. To the extent that high quality, center-based ECE is associated with enhanced early academic skills, rural children may possess fewer academic skills at kindergarten entry.

While center-based care has been found to be more available in urban than rural areas, the extent to which availability differs across large cities, small towns, and suburbs has not been explored. In theory, child care would be more available as the degree of urbanization (and, hence, the degree of commercialization) increases. However, it is possible that in large, population-dense urban cities, the availability of center-based care is outstripped by its demand due to the vast number of people residing in these cities, the expense and limited availability of commercial property, and the increased competition for slots from suburban families who commute to cities for work (Gordon & Chase-Lansdale, 2001). Accordingly, rates of center-based care attendance may vary between large urban cities, small urban areas, and suburbs, leading to differences in early academic skills.

1.3. Gaps in research on urbanicity and child development

Even though important contextual differences exist across urbanicity, there is a lack of psychological research directly comparing how children's development in large urban, small urban, suburban, and rural communities differs. Developmental research has traditionally sampled from urban/suburban populations, leaving questions regarding whether results generalize to rural children. Some rich developmental studies of rural children and families have been conducted (e.g. the Family Life Project and the Iowa Youth and Families Project), but these studies include exclusively rural samples in specific regions of the U.S., which hinders comparisons across the urban–rural continuum (Brody & Flor, 1997; Burchinal, Vernon-Feagans, Cox, & Key Family Life Project Investigators, 2008; Elder & Conger, 2000). An important contribution of the current study is that it situates extant research on rural children within the broader developmental literature using nationally representative data. Indeed, the U.S. Department of Health and Human Services recently noted the importance of examining questions of urbanicity with nationally representative data (Strong, Del Grasso, Burwick, Jethwani, & Ponza, 2005). Notably, there have been two studies using data from the Early Childhood Longitudinal Study, Kindergarten Cohort (ECLS-K) to examine differences between urban and rural children at kindergarten entry (Grace et al., 2006; Lee & Burkham, 2002). Grace and colleagues (2006), comparing rural children to non-rural children, found unadjusted differences in early reading skills, whereby rural children were more than 10% less likely to possess sound and letter recognition skills in kindergarten. Lee and Burkham (2002), controlling for sociodemographic characteristics, found that children living in rural areas and medium-sized cities scored roughly .05–.15 *SD* behind children living in suburbs and large cities in measures of reading and math skills. These studies, however, have limitations. Most significantly, they do not have prospective data on children's early home and ECE experiences preceding their transition to formal schooling. Accordingly, it is unclear how children's early environments explain observed disparities in early academic achievement. The current study advances the literature using data from infancy through kindergarten entry to examine urbanicity-related differences in children's early experiences and their links to academic skills development.

Moreover, this study makes several methodological advances over the current research on urbanicity. Extant studies generally dichotomize area of residence into rural versus urban. The failure to separate out suburbs and small cities introduces substantial heterogeneity into urban/rural classifications. Additionally, urbanicity research primarily uses county-level data, ignoring variability within counties with regard to level of urbanicity (Lichter & Johnson, 2007). Obfuscating heterogeneity within counties and across the urban–rural continuum leads to weak statistical findings regarding urbanicity's association with outcomes (Weber et al., 2005). To address this, we use zip codes to categorize children as residing in large urban cities, small urban areas, suburbs, or rural areas. Lastly, studies of how urbanicity impacts children and families rarely address potential bias in results due to important differences across urban, suburban, and rural families that may relate to early achievement (Weber et al., 2005). The use of propensity score techniques in this study reduces bias created by pre-existing differences in characteristics linked to school readiness among families choosing to live in large cities, small urban areas, suburbs, and rural areas, providing a better estimate of the effect of urbanicity of early academic skills development.

2. Research aims

Currently, the research examining the relationship between urbanicity and children's early academic skills development is limited. Using nationally representative data, this study seeks to fill gaps in the literature by generating less-biased estimates of differences in academic skills at kindergarten entry for children living in large urban, small urban, suburban, and rural areas. Furthermore, it examines variation in children's early experiences across contexts to identify whether home environment and ECE use explain urbanicity-related disparities in early academic skills. It is hypothesized that children living in rural areas and large urban cities will be at greatest risk for low achievement at school entry, and these disparities will be explained, at least in part, by differences in parenting, cognitive stimulation, parental beliefs, and center-based child care enrollment. Results will help inform efforts to ensure that children across the U.S. are academically prepared for kindergarten.

3. Method

3.1. Participants

Data were drawn from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), a nationally representative longitudinal study of a cohort of approximately 10,700 (the ECLS-B requires all *N*s to be rounded to the nearest 50) children born in the U.S. in 2001 (Flanagan & West, 2004). It is a multi-source, multi-method prospective study following the cohort from birth through kindergarten entry, documenting early home and educational experiences and assessing their development. The ECLS-B data are particularly well-suited for this study. The sample is large, nationally representative, and includes children living in areas spanning the urban–rural continuum. Additional demographic data on the sample are presented in Table 1.

Our analytic sample, about 6050 children, contains roughly 93% of the approximately 6500 children who remained in the study through kindergarten. Sampling weights were applied in all analyses to adjust for attrition and allow results to be generalized to a nationally representative birth cohort. Comparisons of children in our analytic sample to those omitted from our analyses

Table 1
Select weighted descriptive statistics for full sample and by urbanicity.

	Full sample ($N \approx 6050$) *M* or % (*SD*)	Large urban core ($N \approx 1050$) *M* or % (*SD*)	Small urban core ($N \approx 1000$) *M* or % (*SD*)	Suburb ($N \approx 2750$) *M* or % (*SD*)	Rural ($N \approx 1300$) *M* or % (*SD*)
Child outcomes					
Reading skills	44.05	41.30	45.42	45.33	42.11
	(14.28)	(14.56)	(13.63)	(14.38)	(13.77)
Math skills	44.13	41.78	44.97	45.26	42.66
	(10.14)	(10.17)	(9.23)	(10.12)	(10.43)
Mediators					
Home environment					
Positive parenting	0.05	−0.12	0.13	0.13	−0.09
	(0.92)	(0.89)	(0.93)	(0.93)	(0.86)
Negative parenting	1.24	1.25	1.23	1.24	1.26
	(0.37)	(0.35)	(0.38)	(0.38)	(0.37)
Cognitive stimulating materials/activities	0.02	−0.06	0.04	0.05	−0.02
	(0.40)	(0.38)	(0.39)	(0.43)	(0.35)
Knowledge of infant development	6.82	6.01	7.20	6.95	6.88
	(2.20)	(2.38)	(2.04)	(2.20)	(1.99)
Conceptions of school readiness	3.87	3.94	3.86	3.87	3.79
	(0.62)	(0.62)	(0.63)	(0.63)	(0.61)
Expectations of educational attainment	4.12	4.30	4.05	4.22	3.76
	(1.19)	(1.30)	(1.16)	(1.12)	(1.23)
Early childhood education and care					
9 months					
Parent care	49.2%	52.6%	50.4%	48.6%	46.2%
Center-based care	8.6%	7.6%	10.0%	8.9%	7.6%
Home-based care	42.2%	39.9%	39.6%	42.4%	46.2%
2 years					
Parent care	50.6%	54.0%	50.9%	50.5%	47.6%
Center-based care	15.9%	15.1%	18.7%	15.3%	15.5%
Home-based care	33.4%	30.9%	30.4%	34.2%	36.9%
Preschool					
Parent care	19.9%	26.2%	20.4%	17.4%	19.8%
Center-based care	59.5%	55.2%	64.6%	62.2%	52.2%
Home-based care	20.6%	18.7%	15.2%	20.5%	28.0%
Child characteristics					
BSF-R 9 mo. cognitive score	50.47	50.44	50.01	50.48	50.91
	(9.64)	(9.45)	(9.28)	(9.75)	(9.87)
Race					
White	54.8%	29.5%	63.4%	54.8%	70.6%
African American	13.8%	24.0%	14.2%	11.5%	9.9%
Hispanic	24.7%	40.0%	17.0%	26.7%	12.2%
Asian	2.2%	2.1%	1.3%	3.2%	0.5%
Native Am./Pacific Islander	0.7%	0.5%	0.4%	0.3%	2.1%
Multiracial	3.9%	3.9%	3.8%	3.5%	4.8%
Low birth weight	7.4%	8.0%	7.3%	7.2%	7.4%
In poor health at any wave	5.7%	7.7%	4.5%	5.4%	5.8%
Parental characteristics					
RPP-adjusted household income	$56,930	$42,370	$52,920	$65,290	$53,100
	($44,120)	($38,630)	($40,570)	($45,760)	($43,280)
Parental Ed.					
Less than high school	6.8%	11.5%	7.7%	4.4%	7.7%
High school diploma/GED	21.6%	26.4%	17.5%	18.6%	28.5%
Some college/votech	35.8%	34.7%	36.0%	34.6%	39.5%
Bachelor's degree	20.7%	16.4%	22.4%	23.9%	15.2%
Master's degree	9.8%	6.6%	10.4%	12.5%	5.6%
Doctorate/prof degree	5.2%	4.4%	6.0%	5.9%	3.6%
Mother stably employed	33.3%	28.2%	37.4%	33.3%	34.1%
Mother stably married	61.6%	51.2%	60.7%	67.0%	58.7%
Maternal CES-D score	5.08	5.25	5.33	4.90	5.15
	(4.74)	(4.82)	(4.77)	(4.73)	(4.63)
Household characteristics					
Average number of children	2.27	2.37	2.27	2.21	2.32
	(1.07)	(1.16)	(1.04)	(1.03)	(1.08)
Geographic region					
Northeast	16.4%	7.5%	18.8%	20.7%	11.9%
Midwest	22.1%	26.7%	18.7%	21.8%	21.4%
South	37.0%	30.3%	42.0%	32.9%	49.2%
West	24.5%	35.5%	20.5%	24.5%	17.5%
Immigrant household	22.9%	34.6%	14.8%	27.0%	8.9%

because of missing data revealed few significant differences. The children in our sample tended to be slightly socioeconomically advantaged compared to children dropped because of missing data. They were more likely to be non-Hispanic White and have higher family incomes and less likely to have an immigrant parent and live in a non-English speaking home. These characteristics were included as covariates in our models.

3.2. Procedure

The ECLS-B collected data at four waves: wave 1 of data collection was conducted when the participants were 9 months of age; wave 2 data were collected at 2 years of age; wave 3 data were collected at 4 years of age; and wave 4|5 data were collected at the start of kindergarten. Not all children had entered kindergarten at wave 4, so the ECLS-B reassessed those children the following year (wave 5) to assess their development at the start of kindergarten. Response rates for wave 1 through wave 4|5 were 74%, 93%, 91%, 92%, and 93% in sequential order. At each wave, the child's primary caregiver was interviewed (the biological mother or female guardian in 99.7% of the cases), and the child's development was assessed.

3.3. Measures

A table containing information regarding the periodicity of the measures used in this study is contained in Appendix A. All characteristics measured at multiple waves were considered time-varying characteristics. Unless otherwise noted, aggregate measures of all time-varying characteristics (i.e. averages across 9 months through 4 years) were used in the models.

3.3.1. Children's academic skills

Kindergarten reading and math skills were measured at wave 4|5 using direct assessments that drew items from well-validated standardized instruments, such as the Preschool Comprehensive Test of Phonological and Print Processing (Pre-CTOPPP), Peabody Picture Vocabulary Test (PPVT), the PreLAS 2000, and the Test of Early Mathematics Ability-3 (TEMA-3). Additionally, items were borrowed from the Family and Child Experiences Study (FACES) and ECLS-K. The reading assessment evaluated early language and literacy skills like letter-sound knowledge, print conventions, word recognition, expressive and receptive vocabulary, interpreting text, and critical reading ($\alpha_4 = .92$; $\alpha_5 = .93$). The mathematics assessment evaluated skills such as number sense, properties, operations, measurement, geometry, spatial sense, data analysis, and patterns ($\alpha_4 = .92$; $\alpha_5 = .92$).

3.3.2. Urbanicity

To measure urbanicity, we used the Rural-Urban Commuting Area (RUCA) Codes created by the U.S. Department of Agriculture. RUCA codes measure population density, urbanization, and daily commuting patterns to identify urbanized areas and adjacent territory that is economically integrated with those cores. RUCA codes are assigned at the census tract-level, which is the smallest building block for which reliable commuting data are available. The RUCA code classification system provides a complete delineation of urbanized areas and adjacent, integrated settlements based on the size and direction of commuting flows.

The ECLS-B contains children's zip codes of residence at 9 months, 2 years, and 4 years. Using zip code approximations of RUCA codes, we calculated children's primary RUCA code at each wave and placed them within four different geographic areas: large urban city; small urban area; suburb; and rural area. Large cities consist of all incorporated municipalities with populations of at least 150,000 people. Small cities include places that have populations of fewer than 150,000 but that anchor urbanized areas of at least 50,000. Suburbs consist of metropolitan areas outside city limits or non-metropolitan places proximal to urbanized areas where 30% or more of the population commutes to an urban city for work. Rural areas consist of areas with populations of fewer than 50,000 that are independent of a metropolis (i.e., less than 30% of the population commutes to a city for work). Dummy variables indicating children's urbanicity for the majority of the time from 9 months through 4 years were included in the models (rural omitted).

3.4. Home environment

3.4.1. Parenting quality

To assess characteristics of parenting, the ECLS-B administered the Two Bags Task to mother-child dyads at 2-years and 4-years (Fauth, Brady-Smith, & Brooks-Gunn, 2003). Dyads were presented with two bags containing a book for joint reading and objects for pretend play. Mothers were instructed to engage in joint book reading first and move on to pretend play at will. Dyads were observed for 10 min and the quality of parent-child interactions was assessed. Positive and negative parental behaviors were rated on a seven-point scale with 1 being "very low" and 7 being "very high." For our analyses, we created a composite of positive parenting behaviors (combining measures of cognitively stimulating parenting, parental sensitivity, and positive regard for child) and negative parenting behaviors (combining measures of negative regard for child, intrusiveness, and detachment). Inter-observer reliability for these observations was between 90% and 97% for both waves. Cumulative measures of positive and negative parenting averaging across the 2- and 4-years waves were used in the models.

3.4.2. Stimulating activities/experiences

Cognitive stimulation in the home was also assessed at each wave of the survey using items from the well-validated Short Form of the Home Observation for Measurement of the Environment Inventory (HOME-SF; Caldwell & Bradley, 2001), the National Household Education Survey (NHES), and several questions constructed by the ECLS-B as part of the parent interview. Items assessed multiple dimensions of home environment, including the cognitive stimulation provided to the child through activities and materials, for example number of books in the home and frequency of trips to the library and zoo. Using these items, composite measures of children's exposure to cognitively stimulating materials and activities at 2 years (6 items, $\alpha = .52$) and 4 years (9 items, $\alpha = .53$) were created and a cumulative measure was used in the analyses by collapsing across the 2- and 4-year waves ($\alpha = .67$).

3.4.3. Parental beliefs and expectations

Maternal knowledge of child development was assessed at 9 months of age using a subset of 11 items from the Knowledge of Infant Development Inventory (KIDI; MacPhee, 1981; National Center for Education Statistics, 2004). Higher scores indicate greater knowledge of developmental milestones and normative behavior. Maternal beliefs about school readiness were assessed at 4 years using items from the School Readiness Interview of the National Household Education Survey. The ECLS-B assessed maternal beliefs about the importance of academic dimensions of school readiness by asking parents to rate how important (1 "essential" to 5 "not important at all") it is that children display certain academic skills such as counting, writing one's name, and knowing the alphabet before they start school. These items were reverse coded, so that higher scores represent more importance placed on academic school readiness skills by parents, and a composite measure (7 items; $\alpha_3 = .87$) was used. Lastly, parental expectations for children's educational attainment were also assessed at 4 years with a

question asking how far they expected their children to go in school (1 "less than high school diploma" to 6 "professional degree").

3.4.4. Child care type

At the 9-month, 2-year, and 4-year waves of the survey, parents reported on regular non-parental care settings that their children experienced. Dummy variables were created indicating which type of child care children experienced—center-based (pre-kindergarten, Head Start, or other centers), home-based (relative or non-relative), or parent-care (reference group) at each wave of the survey. Children in regular non-parental care settings for less than 5 h per week and children who did not experience regular non-parental care were coded as being in parent-care. All other children were coded into center-based or home-based care depending on where they spent the most hours during the week. Children who experienced the same number of hours in center-based and home-based care settings were coded into the center-based category.

3.4.5. Child, parental and household covariates

To obtain a better estimate of the impact of urbanicity on academic development, we controlled for numerous child, parental, and household characteristics that are associated with achievement. Child covariates included gender, child age in months measured at the time of the kindergarten assessment, and an indicator for the wave at which the child began kindergarten. Child birth weight was represented with a dummy variable indicating whether the child was born low (less than 2500 g) birth weight. Child health condition was also represented as a dummy variable capturing whether parent reported that the child was of fair or poor health at any time from 9 months to 4 years. Child race/ethnicity was categorized as non-Hispanic White (reference group), non-Hispanic African American, Hispanic, Asian, Native American, and multiracial. Lastly, the ECLS-B assessed cognitive ability at 9 months using the Bayley Short Form – Research Edition (BSF-R; $\alpha = .80$), which was adapted for use from the Bayley Scales of Infant Development (BSID-II; Bayley, 1993). The BSF-R assesses cognitive development across diverse domains, including exploration of objects, babbling, early problem-solving, and preverbal communication (Flanagan & West, 2004).

Several parental characteristics were included as covariates, including family income, highest level of parental education, maternal employment, depression, and marital status. At each wave, the child's primary caregiver was asked to report total household income in the previous year. Cumulative family income adjusted for geographical cost-of-living differences was used in the analyses (Renwick, 2009). Parental education was represented as a series of dummy variables indicating whether the highest level of attainment was less than a high school degree, high school degree/GED (reference group), some college or vocational school, Bachelor's degree, Master's degree, or Doctorate/professional degree. Maternal employment was categorized dichotomously as whether mothers were stably employed from 9 months through 4 years. An indicator for whether mothers ever worked non-standard work hours (defined as hours outside of 6:00 a.m. to 6:00 p.m.) at 9 months, 2 years, or 4 years was also included. Maternal depression was assessed at the 9-month and 4-year waves using a version of the Center for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977). The CES-D score is a continuous measure with higher scores indicating increased severity of depression. Marital status was measured with an indicator of whether the child's mother was married at each 9 months, 2 years, and 4 years.

Similarly, household characteristics were also included in the models. A variable measuring the number of children in the household was included. We created dummy variables indicating whether the household was located in South, West, Northeast (reference group), or Midwest according to U.S. Census region definitions. Children were assigned to a region based on where they resided for the majority of the time from 9 months through 4 years. In addition, a dichotomous indicator was used to identify immigrant households, defined as households where at least one parent was born outside of the U.S., including U.S. territories. An indicator for whether the child lived in a house where the primary language of the household was non-English at any wave from 9 months to 4 years was also included.

4. Data analysis

In our analyses, associations between urbanicity and academic skills at kindergarten entry were modeled using a lagged OLS regression model that predicts academic skills at kindergarten entry (wave 4|5), controlling for cognitive scores at 9 months, and child, parental, and household characteristics. The autoregressive model is based on the accumulation of inputs model articulated by NICHD ECCRN and Duncan (2003), which suggests that a child's development at kindergarten entry is a function of all child inputs, parental inputs, household inputs, and child care inputs to the child's development up to that point in time. Accordingly, we tested the main effects of urbanicity by modeling academic skills as a function of urbanicity, children's 9 month cognitive score, child characteristics (gender, age at assessment, wave child began kindergarten, birth weight, health, race/ethnicity), parental characteristics (income, parental education, maternal employment, maternal work schedule, maternal depression, and maternal marital status), and household characteristics (number of children in the household, region, immigrant family, non-English speaking household) using the following equation:

$$\begin{aligned}\text{Achievement}_{4|5i} = {} & B_0 + B_1\text{Large urban}_{123i} + B_2\text{Small urban}_{123i} \\ & + B_3\text{Suburban}_{123i} + B_4\text{Cognitive score}_{1i} \\ & + B_5\text{Child}_{123i} + B_6\text{Parental}_{123i} \\ & + B_7\text{Household}_{123i} + \varepsilon_t. \end{aligned} \quad (1)$$

We included the child, parental, and household factors as covariates to reduce the threat of selection bias that may arise if characteristics of children and their parents impact both achievement and families' decisions about where to live. The 9-month measure of cognitive ability was included as an additional covariate, allowing us to control for unmeasured, time-invariant differences in children and families that affect children's cognitive development (Chase-Lansdale et al., 2003), thus reducing concerns of omitted variable bias. Wald post hoc tests were conducted to determine whether there were significant differences in academic achievement across the urbanicity groups.

Following the primary models delineated above, we used propensity score weighting methods to replicate significant results from the nationally representative, lagged OLS models. Propensity score methods restructure correlational data to mimic randomized experimental data where a "treatment" group and "control" group are matched on observed, preexisting characteristics (Rosenbaum & Rubin, 1983). To conduct the propensity score analyses (PSA), we ran a series of models comparing children living in one urbanicity, i.e. the "treatment" group, to children living in another, i.e. the "control" group. PSA for all possible urbanicity pairings were conducted, resulting in a total of 6 comparisons. For each comparison, the propensity of living in the "treatment" urbanicity was estimated as a function of observed covariates using probit regression. All covariates contained in the nationally representative OLS models were included in the probit model (i.e. 9 month cognitive score, gender, age, kindergarten wave, birth weight, health, race/ethnicity, family income, parental education, maternal employment, maternal

work schedule, maternal depression, and maternal marital status, number of children in the household, region, immigrant family, non-English speaking household). Children in different urbanicities who have the same propensity scores should have the same joint distribution of covariates (Rosenbaum & Rubin, 1983). The regression analysis was then rerun using inverse probability of treatment weighting, which sets weights equal to the inverse of the child's conditional probability of living in the urbanicity in which the child actually lived multiplied by population weights (Hirano & Imbens, 2001; Hong & Yu, 2008; Lunceford & Davidian, 2004).

To provide a concrete example of the process, when testing whether living in rural areas was related to worse academic skills compared to living in large urban cities, we first estimated the propensity of living in a rural area using the subsample of children who lived in rural or large urban areas. Then the propensity scores from that model were used to create probability weights that were equal to the inverse of the probability of living in a rural area for rural children (1/propensity score) and the inverse of the probability of living in a large urban area for the large urban children (1/(1 − propensity score)). Finally, with propensity score weights applied, we ran regression analyses on the subsample of children living in rural or large urban areas that predicted academic skills with the rural dummy variable and covariates. This processes was repeated for all urbanicity group comparisons. Propensity score weighting helps remove selection bias associated with observed covariates, leading to a less-biased estimate of the urbanicity effect (Hirano & Imbens, 2001; Hong & Yu, 2008; Lunceford & Davidian, 2004; Rosenbaum & Rubin, 1983). It is, of course, still possible that children and families may differentially select into urbanicities based on unmeasured characteristics.

Lastly, we tested whether home and ECE experiences are pathways through which urbanicity relates to early reading and math skills. To do so, Eq. (1) was estimated with the measures of positive parenting, negative parenting, cognitive stimulation, parental knowledge of child development, parental beliefs regarding school readiness, parental expectations for academic attainment, and child care type as dependent variables to determine whether there are significant differences in home environment and ECE type depending on urbanicity. Then we added the hypothesized mediators into Eq. (1) to examine their influence on achievement. Formal tests of mediation using Sobel's product of coefficients method were conducted to estimate the statistical significance of the indirect effects of urbanicity on kindergarten readiness skills operating through dimensions of parenting and ECE experiences (MacKinnon, Warsi, & Dwyer, 1995).

5. Results

Descriptive statistics are presented in Table 1. The number of children residing in large urban, small city, suburban, and rural areas was roughly 1050 (17.2%), 1000 (16.4%), 2750 (45.1%), and 1300 (21.3%) respectively. There were large differences across the groups in terms of sociodemographic characteristics. Rural children were more likely to be Non-Hispanic White and less likely to be Hispanic, born to an immigrant, or living in a non-English speaking household. Children residing in large urban cities were more likely to be Hispanic or African-American, born of immigrant parents, and living in a non-English speaking home and less likely to be White. Suburban households made, on average, over $10,000 more per year in income than the families living in any other area, with an average household income of $65,920. Suburban families were also the most educated group. Large urban households earned about $10,000 less than households in any other area. Looking at the sample as a whole, 37.0% of the families lived in the South, 24.5% lived in the West, 22.1% lived in the Midwest, and 16.4% lived in the Northeast. When compared to families living in other urbanicity categories, those living in rural areas were more likely to reside in the South, and large urban families were less likely to reside in the Northeast and more likely to reside in the West.

In an effort to determine whether the sample of large urban, small urban, suburban, and rural families in this study was representative of those in the national population, we compared select descriptive statistics from our data to data from the U.S. 2010 Decennial Census. Comparisons between data sources, while not ideal due to discrepancies between urbanicity categories in this study and those used by the Census Bureau, provide some indication of the representativeness of our sample. Descriptive statistics for our analytic sample were quite consistent with national statistics. For example, as of the 2010 Census, 58.3% of the U.S. population lived in large urbanized areas (large urban and suburban areas in our categorization), 10.4% lived in small urbanized areas (roughly corresponding to our small urban category), 10.6% lived in urban clusters (suburbs and rural areas in our categorization) and 20.8% lived in rural areas, which is similar to the proportion of families falling into each urbanicity category in our sample. Demographic and socioeconomic characteristics of the subsamples also corresponded with Census data; differences in family income, race/ethnicity, educational attainment and family structure across urbanicities in this analytic sample mapped on to differences observed in the Census data (results available from author by request).

Table 1 illustrates unadjusted mean differences in children's reading and math skills, home environments, and ECE experiences across large urban, small urban, suburban, and rural areas. With respect to academic skills, the overall pattern of findings shows that children living in rural and large urban areas begin kindergarten with less advanced reading and math skills than do children from small urban areas and suburbs. More specifically, rural children lag about 2–3 points (or .20 of a standard deviation (*SD*)) behind children living in small urban and suburban areas in tests of reading and math skills, while children residing in large urban areas score roughly 3–4 points (or approximately .30 *SD*) worse than their small urban and suburban peers. Similarly, unadjusted differences in children's home environments and ECE experiences across urbanicities were also observed. In general, large urban homes and, to a lesser degree, rural homes scored worst on measures of the home environment. These families tended to display the least positive parenting, expose children to the fewest stimulating materials and experiences, and knew the least about child development. Notably, the pattern shifts with respect to parents' reports of the importance of school readiness skills and educational expectations for their children. Parents living in large urban areas, despite being relatively socioeconomically disadvantaged, placed more importance on academic school readiness skills and had higher expectations for their children's educational attainment than did parents living in small urban, suburban, and rural areas. Rural parents reported placing less importance on academic skills prior to kindergarten entry and having lower expectations for their children's educational attainment compared to parents living in other urbanicities. There were also unadjusted differences in ECE use. Families in large urban cities disproportionately relied on parent care, families in small urban areas used relatively more center-based care, and rural families used relatively more home-based care.

5.1. Urbanicity's association with kindergarten academic skills

Table 2 presents the nationally representative and PSA-adjusted estimates of the main effects of urbanicity on academic skills at kindergarten-entry. Both modeling techniques revealed significant differences in academic skills related to urbanicity even after adjusting for confounding characteristics. Results from nationally

Table 2
Nationally representative and PSA estimates of adjusted differences in reading & math skills across urbanicity.

	Reading			Math		
	Coeff.	(*SE*)	Effect Sz.	Coeff.	(*SE*)	Effect Sz.
Nationally rep. models						
Large urban	0.50	(0.73)		0.46	(0.52)	
Small urban	2.21**	(0.74)	0.16 SD	1.60**	(0.51)	0.16 SD
Suburban	1.59*	(0.63)	0.11 SD	1.48**	(0.45)	0.15 SD
Wald post hoc results						
Small urban–large urban	1.64*		0.11 SD	1.09*		0.11 SD
Suburban–large urban	0.99			0.95*		0.09 SD
Small urban–suburban	0.65			0.14		
PSA models						
Rural (reference) vs. large urban	0.00	(0.83)		−0.18	(0.60)	
Rural (reference) vs. small urban	2.46**	(0.76)	0.17 SD	1.66**	(0.51)	0.16 SD
Rural (reference) vs. suburban	1.16	(0.67)		1.29**	(0.49)	0.13 SD
Large urban (reference) vs. small urban	1.75*	(0.78)	0.12 SD	1.26*	(0.52)	0.12 SD
Large urban (reference) vs. suburban	0.85	(0.66)		0.70	(0.46)	
Suburban (reference) vs. small urban	0.46	(0.65)		0.10	(0.41)	
Mediated models						
Large urban	−0.08	(0.72)		0.10	(0.52)	
Small urban	1.47*	(0.73)	0.10 SD	1.10*	(0.50)	0.11 SD
Suburban	1.04	(0.62)		1.14*	(0.44)	0.11 SD
Wald post hoc results						
Small urban–large urban	1.55*		0.11 SD	1.00*		0.10 SD
Suburban–large urban	1.12			1.04*		0.10 SD
Small urban–suburban	0.43			0.04		

In OLS models ($N \approx 6050$), large urban, small urban and suburban are compared to the omitted category of rural. In PSA models, $N \approx 2350$ for large urban vs. rural comparison, $N \approx 2300$ for small urban vs. rural comparison, $N \approx 4000$ for suburban vs. rural comparison, $N \approx 2050$ for large urban vs. small urban comparison, $N \approx 3750$ for large urban vs. suburban comparison, and $N \approx 3700$ for small urban vs. suburban comparison.
Covariates included in all models are 9 month cognitive score, gender, age, kindergarten wave, birth weight, health, race/ethnicity, family income, parental education, maternal employment, maternal work schedule, maternal depression, and maternal marital status, number of children in the household, region, immigrant family, and non-English speaking household.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

representative models show that children living in rural areas performed worse in both reading and math than did children living in small urban (.16 *SD* for both reading and math) and suburban areas (.11 *SD* for reading and .15 *SD* for math). Likewise, children from small urban settings had a small advantage over large urban children in reading and math skills (.11 *SD*). Suburban children slightly outperformed large city children in math (.09 *SD*). These results are largely robust to the more stringent PSA as illustrated in the second panel of Table 2. The disadvantage in academic skills faced by rural children in comparison to small urban and suburban children held in the PSA models save for the gap in math skills compared to suburban children, which was no longer conventionally significant. The achievement gaps for large urban children replicated when compared to small urban children but did not when compared to suburban children. Notably, mean differences observed between children living in rural areas and large cities compared to children in small urban areas actually grew slightly once PSA weights were applied. Conversely, gaps between rural and large urban children compared to suburban children shrunk 13–27% after applying the PSA weights.

5.2. Children's home and ECE experiences by urbanicity

Having identified mean differences in children's achievement scores as a function of urbanicity, we turned our attention to key home and ECE experiences that were hypothesized as pathways through which urbanicity may be linked to early academic skills. As shown in Table 3, there were significant differences in children's home and ECE experiences related to urbanicity even after accounting for demographic and socioeconomic differences among families. Rural home environments tended to look worse than did the home environments in other urbanicity contexts. Rural children, on average, tended to experience less positive parenting (.20–.22 *SD*), fewer stimulating materials and experiences (.13–.15 *SD*), and their parents held lower expectations for their academic attainment (.11–.18 *SD*) compared to children residing in all other contexts. In addition, rural parents had less knowledge of child development than parents living in small cities (.15 *SD*). On the other hand, the home environments of children living in large urban areas looked quite similar to those of small urban and suburban children after taking into account that large urban families were more socioeconomically disadvantaged. Parents living in large urban cities, however, possessed less child development knowledge than small city and suburban parents (.22 *SD* and .15 *SD*, respectively). There was also a significant difference between large urban and suburban children with respect to negative parenting, such that suburban children experienced slightly more negative parenting (.11 *SD*) than did children in large urban cities.

There were also urbanicity-related differences in children's ECE experiences. Rural children were more likely to experience parental care in infancy and toddlerhood when compared to more urban children. Rural families also used home-based child care settings more often than more urban families throughout early childhood. Lastly, rural children attended center-based care at lesser rates than children in small urban areas and suburbs at preschool. Among the other groups, there were some small but significant differences in patterns of ECE use at age 4. Children in large urban cities experienced slightly more parent care than did suburban children. Children in small urban cities attended home-based care at slightly lesser rates than did suburban children.

Table 3
Nationally representative OLS estimates of adjusted differences in mediators across urbanicity.

Home environment					
Positive parenting Coeff. (*SE*) Effect Sz.	Negative parenting Coeff. (*SE*) Effect Sz.	Stim. materials/activities Coeff. (*SE*) Effect Sz.	Child dev. knowledge Coeff. (*SE*) Effect Sz.	Sch. readiness beliefs Coeff. (*SE*) Effect Sz.	Educational expectations Coeff. (*SE*) Effect Sz.
Large urban					
0.20***	−0.02[a]	0.06**	−0.14[ab]	0.05	0.21**
(0.05)	(0.02)	(0.02)	(0.12)	(0.04)	(0.07)
0.22 SD		0.15 SD			0.18 SD
Small urban					
0.19***	−0.02	0.05*	0.34**[a]	0.07	0.14*
(0.05)	(0.02)	(0.02)	(0.11)	(0.04)	(0.07)
0.21 SD		0.13 SD	0.15 SD		0.12 SD
Suburban					
0.18***	0.02[a]	0.05**	0.18 [b]	0.05	0.13*
(0.04)	(0.02)	(0.02)	(0.09)	(0.03)	(0.06)
0.20 SD		0.13 SD			0.11 SD

Child care experiences								
9 months			2 years			4 years		
Parent Coeff. (*SE*)	Center Coeff. (*SE*)	Home Coeff. (*SE*)	Parent Coeff. (*SE*)	Center Coeff. (*SE*)	Home Coeff. (*SE*)	Parent Coeff. (*SE*)	Center Coeff. (*SE*)	Home Coeff. (*SE*)
Large urban								
0.05	0.02	−0.07*	0.07*	0.01	−0.08**	0.06*[a]	0.05	−0.11***
(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Small urban								
0.06*	0.03	−0.08**	0.06*	0.02	−0.08**	0.03	0.10**	−0.13***[a]
(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)
Suburban								
0.03	0.02	−0.06*	0.06**	−0.01	−0.05*	0.01[a]	0.06*	−0.07**[a]
(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)

Note. $N \approx 6050$. Large urban, small urban and suburban are compared to the omitted category of rural. Within each column, groups with shared superscript letters are different from each other at the $p < .05$ level.
Covariates included in all models are 9 month cognitive score, gender, age, kindergarten wave, birth weight, health, race/ethnicity, family income, parental education, maternal employment, maternal work schedule, maternal depression, and maternal marital status, number of children in the household, region, immigrant family, and non-English speaking household.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

5.3. Mediation of the differences in kindergarten academic skills

To address the final aim of this study, which considers whether differences in children's early experiences at home and in child care partially account for heterogeneity in achievement related to urbanicity, measures of these early environments were added to the nationally representative OLS regression models. The last panel of Table 2 displays the direct effect of urbanicity on reading and math skills after introducing the mediators into the models. In Table 4, column 1 provides a list of all significant mediated effects. Column 2 of Table 4 lists the effect of urbanicity on the mediator (alpha coefficient), and column 3 lists the effect of the mediator on achievement (beta coefficient). Lastly, column 4 contains the product of coefficients, and column 5 shows the proportion of the overall adjusted difference between urbanicity groups that is explained by the specific indirect effect. As seen in Table 4, the early academic benefits of living in small urban and suburban areas over rural areas were partially mediated by differences in children's early experiences. Lower-quality home environments experienced by rural children were important in explaining why they started kindergarten with fewer academic skills than small city and suburban children. Less positive parenting experienced by rural children partially mediated gaps in both reading and math achievement, accounting for 6–9% of the total effect of urbanicity on achievement. Rural children's lower level of exposure to cognitively stimulating materials and activities partly mediated approximately 5% of the total rural disadvantage in math skills. Rural parents' lesser knowledge of child development in comparison to small city parents helped explain 5–8% of the differences in reading and math skills between rural and small city children. Lastly, rural parents' diminished expectations regarding their children's future academic attainment mediated 7% of the total reading lag faced by rural children in comparison to suburban children. Child care type also helped explain the rural gap in achievement; the increased use of home-based care in comparison to center-based care at preschool by rural families partially explained the difference in reading skills between rural children and children living in small urban and suburban areas, accounting for 9–12% of the total effect of rural residence. The inclusion of the mediators attenuated rural–small urban gaps in achievement by roughly one-third. Suburban children's academic advantage over rural children shrunk by 35% for reading and 23% for math. Notably, the difference in reading skills between rural and suburban children was no longer significant after the inclusion of the mediators. Math disparities and the rural–small urban reading gap remained, however, even after the addition of home environment and child care measures.

With respect to the achievement gap related to large urban residence, formal tests revealed little evidence of home and ECE experiences mediating achievement disparities, though a few significant indirect effects were important for explaining large urban-small urban achievement gaps. The decreased knowledge of child development possessed by parents in large urban areas

Table 4
Results of mediation analyses.

Significant mediated effects	Urbanicity → mediator Coeff. (*SE*)	Mediator → outcome Coeff. (*SE*)	Indirect effect (α)(β) (*SE*)	% of gap explained by indirect effect
Rural (reference) vs. small urban				
Positive parenting → reading	0.19***	0.75*	0.14*	6%
	(0.05)	(0.31)	(0.07)	
Positive parenting → math	0.19***	0.49*	0.09*	6%
	(0.05)	(0.20)	(0.05)	
Stim. materials/activities → math	0.05*	1.68***	0.08*	5%
	(0.02)	(0.42)	(0.04)	
Child dev. knowledge → reading	0.34**	0.33*	0.11*	5%
	(0.11)	(0.13)	(0.06)	
Child dev. knowledge → math	0.34**	0.34***	0.12*	8%
	(0.11)	(0.08)	(0.05)	
Home care → reading	−0.13***	−2.06**	0.27**	12%
	(0.03)	(0.62)	(.10)	
Rural (reference) vs. suburban				
Positive parenting → reading	0.18***	0.75*	0.14*	9%
	(0.04)	(0.31)	(0.06)	
Positive parenting → math	0.18***	0.49*	0.09*	6%
	(0.04)	(0.20)	(0.04)	
Stim. materials/activities → math	0.05**	1.68***	0.08*	5%
	(0.02)	(0.42)	(0.04)	
Educational expectations → reading	0.13*	0.88***	0.11*	7%
	(0.06)	(0.21)	(0.06)	
Home care → reading	−0.07***	−2.06**	0.14*	9%
	(0.02)	(0.62)	(0.06)	
Large urban (reference) vs. small urban				
Child dev. knowledge → reading	0.48***	0.33*	0.16*	10%
	(0.12)	(0.13)	(0.07)	
Child dev. knowledge → math	0.48***	0.34***	0.16**	15%
	(0.12)	(0.08)	(0.06)	
Large urban (reference) vs. suburban				
Child dev. knowledge → math	.32***	0.34***	0.11*	12%
	(0.10)	(0.08)	(0.04)	

Note. $N \approx 6050$. All analyses included child, parental, and household covariates.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

partly explained why their children had fewer reading and math skills compared to small city and suburban children. Specifically, differences in child development knowledge accounted for 10–15% of the total effect of large urban residence on academic skills. Even after including mediators in the models, however, children living in large urban areas still have lower academic achievement at kindergarten entry than children in small cities and suburbs. Indeed, the size of these gaps was unchanged by the addition of mediators in the model.

6. Discussion

6.1. Differences in early achievement related to urbanicity

The literature with respect to early academic skills has repeatedly demonstrated that children who begin kindergarten with strong literacy and numeracy skills have a much higher probability of continued academic achievement in comparison to their peers, leading to greater educational attainment and adult success (Duncan et al., 2007; Heckman, 2000). Analyzing a large, nationally representative sample, we found that children living in rural and large urban areas begin kindergarten with less advanced academic skills than children living in small cities and suburbs. This is consistent with prior data showing lags in rural kindergartener's academic skills when compared to non-rural children (Grace et al., 2006; Lee & Burkham, 2002), though results showing deficits in the kindergarten academic skills of children living in large urban cities is novel. Notably, similar patterns of achievement disparities in high school students have been found using the National Education Longitudinal Study (Roscigno et al., 2006). This study suggest that these differences may emerge much earlier in the life course. Importantly, these urbanicity-related gaps in early achievement persist using rigorous nationally representative, lagged OLS models and propensity score weighting techniques that account for pre-existing differences among families in large urban, small urban, suburban, and rural areas in factors linked to early achievement. Thus, the observed relationship between rural and large urban residence and decreased school readiness skills is over and above differences in the background characteristics of residents across the urban–rural continuum, suggesting that there may be important aspects of urban, suburban, and rural contexts, themselves, that influence child development.

It is important to note the relatively small size of the relationships between urbanicity and early academic skills observed in this study. Effect sizes ranged from .11 to .17 *SD* across models, with larger effect sizes for the rural disadvantage and the small urban advantage. However, keeping in mind that gaps in achievement may grow throughout the elementary school years (e.g., Heckman, 2006), these small disparities have practical significance. Additionally, the small effect sizes may be attributable to heterogeneity in our urbanicity categories. While analyzing nationally representative data has considerable advantages in terms of generalizability of results, it also has some drawbacks, most notably the amalgamation of urban, suburban, and rural communities across the U.S. into four categories. It is probable that the size of the rural and large urban school readiness gaps is much greater for certain subgroups or in particular parts of the country.

6.2. Mediation of early achievement disparities related to urbanicity

This study advances the current literature on school readiness disparities linked to urbanicity by formally testing whether home and child care experiences are pathways through which urbanicity relates to academic development. In fact, we found that urbanicity-related gaps in early achievement could be partially explained by differences in children's home environments and child care arrangements across the urban–rural continuum. Rural children start kindergarten with fewer reading and math skills than small town and suburban children in part because they experience less positive parenting, fewer educational materials and activities, and their parents have less knowledge about how children develop and lower expectations regarding their children's future academic attainment. Additionally, rural children attend center-based care settings at lesser rates during their preschool years, which also explains why rural children have less-advanced early reading skills than small town and suburban children. These results may suggest that geographic isolation in rural areas harms early academic skills development by limiting the availability of important resources that promote achievement. For instance, our findings that the gap in achievement associated with rural residence is partially explained by fewer cognitively stimulating experiences and less use of center-based preschool support the idea that rural families may have more difficulty accessing developmentally salient resources like libraries, museums, and center-based child care settings (Vernon-Feagans et al., 2008), which has negative implications for the development of early reading and math skills in rural areas.

Mediation results also provide evidence that there may be differences in parenting practices and norms across the urban–rural continuum that relate to children's early academic development. For instance, consistent with prior studies, rural parents in our sample provide less warm and responsive parenting, are less knowledgeable about how children develop, and have lower expectations for their children academic attainment (Bornstein et al., 2008; McCracken & Barcinas, 1991; Pinderhughes et al., 2001). This study advances the literature by showing that these differences in parenting and beliefs appear partly responsible for gaps in early achievement experienced by rural children. Similarly, the findings that urban and suburban parents generally invest more in educational materials and activities, have higher expectations for their children's academic futures and have an increased understanding of children's development support the idea that the parenting norms in more urban areas may be more educationally focused than the norms in rural areas (Chou, Crider, & Willits, 1982; Lampard et al., 2000). Interestingly, while prior research suggests decreased educational investments by parents of rural high school students (Roscigno et al., 2006), this study establishes that differences in rural and more urban parents' norms regarding education may appear before children step foot in the classroom. It is important to note, however, that the ECLS-B contains a relatively limited set of items pertaining to parenting beliefs, norms, and practices. For instance, it would have been interesting to explore differences in families' achievement socialization practices as a mediator of school readiness disparities. Thus, caution must be taken when drawing conclusions regarding differences in parenting culture across urbanicities from this study.

Only one aspect of children's home and ECE experiences—knowledge of child development—acted to mediate the negative association between living in a large urban city and early achievement. Indeed, children living in large urban areas had lower levels of achievement despite that their homes consistently ranked among the highest on measures of home environment. This suggests that there are factors excluded from our analyses that explain why the academic skills of children in large cities lag behind children growing up in suburbs and small cities. Indeed, there are several other important aspects of the family context and home learning environment that are not captured in these data like, for instance, frequency and quality of language exposure. Differences in unmeasured characteristics of the home environment may be mediating the association between residence in large urban cities and decreased early achievement. Looking outside of the family context, aspects of the physical environment that children experience in large urban areas may be contributing to our findings. Substantial research has documented how environmental assaults can have negative effects on child development (Evans, 2006). Chronic environmental stress produces psychophysiological effects on young children ranging from elevated levels of stress hormones, increased blood pressure, ignoring auditory stimuli, to failure to attune that threaten early cognitive and academic development (Evans, Brooks-Gunn, & Klebanov, 2011). Children living in large inner-cities often experience such chronic environmental risks as air and lead pollution, noise, crowding, substandard housing, and random crime (Evans & Kantrowitz, 2002). Moreover, children living in large urban areas may have less access to outdoor space for play and exploration, which has been linked to positive development (Coley, 2012; Faber Taylor & Kuo, 2006; Wells & Evans, 2003). A recent study by Coley (2012) found that children's ability to actively explore and interact with natural settings accelerated their ecological reasoning skills, while structured educational experiences, like visits to the zoo and aquarium, did not. To the extent that children living in large urban centers are afforded less unstructured, "hands on" learning experiences, their academic development may suffer as a result.

6.3. Comparing ends of the continuum: urban and rural children

Lastly, another striking finding of this study is that children living in rural areas and large urban cities look surprisingly similar in terms of kindergarten academic performance and many socioeconomic characteristics, yet their early home and child care experiences look starkly different. While we may conventionally assume that large inner-cities and rural areas represent antithetical developmental contexts, our results suggest that, at least for the purposes of the development of early academic skills, these contexts relate to children's development in similar ways. Though our results suggest that the explanations for gaps in achievement related to living in large inner-cities and rural areas are different. More research is warranted to further understand how children living in these dissimilar contexts end up entering kindergarten with less advanced academic skills in comparison to peers in smaller cities and suburbs. Additionally, similarities between children living in large cities and rural areas in comparison to children living in smaller cities and suburbs highlight the importance of studying variation in developmental contexts across the urban–rural continuum, as opposed to dichotomizing urbanicity. Studies characterizing urbanicity as rural versus urban or metropolitan versus non-metropolitan are likely to obscure significant differences in between children living in large cities, small cities, suburbs, and rural areas.

6.4. Limitations and future directions

Despite significant efforts made to control for endogeneity biases, these results are correlational and, hence, must be interpreted with caution. Accordingly, while the correlational design of this study provides a rich description of the early lives of children across urbanicity, it is possible that the observed associations between urbanicity, early home and ECE experiences, and academic achievement are caused by some unmeasured characteristics of the parents or children in our sample.

Also, the use of nationally representative data likely introduced significant heterogeneity in our urbanicity categories. Nationally representative data allows us to draw conclusions regarding the early experiences and functioning of urban, suburban, and rural children living across the U.S., but it prevents us from focusing on specific urban, suburban, and rural communities that are near identical in character. To the extent that there are within-urbanicity differences in urban, suburban, and rural communities, the relationship between urbanicity and achievement will be heterogeneous among contexts. For instance, it may be that growing up in a rural community in the Northeast has different implications for child development than living in a rural area in the Southwest. Future research should explore moderators of the relationship between urbanicity and early academic skills development, like region, race/ethnicity, and socioeconomic status.

Along those lines, in addition to the importance of studying moderators of mean differences in achievement across urbanicity, future work should explore whether urbanicity, itself, moderates the relationship between other inputs to children's early development. For example, other research has shown that family income's relationship with children's early achievement differs across the urban–rural continuum (Miller, Votruba-Drzal, & Setodji, in press). Specifically, using ECLS-B data, Miller and colleagues (in press) show that increases in family income are associated with the greatest improvements in early academic skills in large urban areas and only slight improvements in rural areas. These findings may be partly explained by decreased resource availability, increased socioeconomic integration of residents, and strong community ties in rural areas, all of which result in the early experiences of poor and non-poor children to look more similar in rural areas compared to more urban areas. Differences such as these across urbanicity contexts may alter links between other predictors of academic performance, such as parental education, child care, and parenting. This is an important issue for researchers to tackle in the future. Important to this study, we did test whether the association between our home environment and ECE mediators differed across urban, suburban, and rural areas and found little evidence that these processes functioned differently by urbanicity. There was one notable exception with respect to infant center-based care whereby experiencing center care at 9 months appeared to have less positive or more detrimental relations with reading and math skills in rural areas, though this finding did not impact mediation results since there were no differences across urbanicity in rates of infant center care use.

Lastly, we were unable to directly measure availability of resources in this study. Thus, we can only infer that the lack of use of center-based care and lower quality learning environments in rural homes is influenced by lack of access to resources in rural areas. Future research should utilize more specific availability measures using methods such as Geographic Information Systems (GIS) to directly map distances from children's homes to important resources. In addition, future studies examining availability of resources in urban, suburban, and rural areas could use administrative data, like data from the Census Bureau, to more precisely capture the presence and number of resources within children's neighborhoods. Furthermore, this study did not examine whether other important aspects of ECE experiences, such as the quality of the setting and parental preferences regarding the type and extent of care, mediate urbanicity-related disparities in early achievement. These aspects may impact how ECE influences early academic skills development. For example, decreased use of center-based preschool in rural areas may be due to rural parents' preference for home-based or parental care rather than availability constraints (Shoffner, 1986). Indeed, evidence on child care preferences in our data show that, when compared to both small urban and suburban parents, rural parents are less likely to report that finding child care that prepares their children for kindergarten is important. Center-based preschool may not have the same beneficial impacts we see in other studies if parents feel uncomfortable about enrolling their children or do not reinforce the skills taught in preschool at home. Moreover, policies aimed at increasing access to formal preschool programs in rural areas may not increase rural children's attendance in center-based preschool if rural parents are unwilling to enroll their children. Secondly, given that there is evidence that child care quality differs by urbanicity (Beach, 1995; Kisker et al., 1991), and ECE quality has been found to relate to early achievement (Loeb et al., 2004; Magnuson et al., 2004), it may be an important factor in explaining achievement gaps across the urban–rural continuum. While the ECLS-B assessed ECE quality for a subsample of children, these measures do not predict early achievement. Accordingly, we could not examine quality as a potential mediator of the urbanicity-achievement relationship in this study. Future research should take care to account for both the quality of ECE and parents' child care preferences to better parse apart the potential academic benefits of center-based ECE programs across the urban-rural continuum.

7. Conclusion

This study makes important contributions to our knowledge base regarding children's school readiness skills across urban, suburban, and rural contexts. Using a nationally representative sample of children, we find that children living in rural areas and large urban cities have less advanced reading and math skills at kindergarten entry than do children living in suburbs and small cities. We observe urbanicity-related achievement gaps using advanced methodological techniques to account for selection biases, a novelty in the literature. Moreover, this study advances the literature by exploring the pathways through which urbanicity relates to academic skills development. Results show that aspects of children's home environment and the use of center-based preschool, which have been linked to the development of early literacy and numeracy skills in predominately urban samples, also appear to be important factors in rural children's academic development.

Our findings of differences in children's acquisition of academic skills and early experiences across urbanicity have interesting implications for bioecological theories of child development (Bronfenbrenner & Morris, 1998). This study supports viewing urbanicity as an important macrosystem that influences child development through its relationship with children's proximal home and ECE environments. In particular, differences in parenting beliefs and expectations and exposure to cognitive stimulation and center-based child care suggest that there may be important differences in parenting, availability of resources, and community capital in large metropolises, small cities, suburbs, and rural areas. Since, the urban–rural continuum represents unique contexts for child development, the processes that ultimately drive child development may evolve differently across the continuum. As such, it is vital to consider urbanicity as a context for child development in future research. Furthermore, our findings may have implications for policies aimed at reducing school readiness disparities. Like children raised in inner-cities, rural children are at risk for low academic achievement at school entry. Our results imply that lack of access to resources in rural areas may be negatively impacting the early achievement of rural children. For instance, lower enrollment in center-based preschool suggests that rural families may not have adequate access to this important resource. In addition, lower parenting quality, educational expectations, and child development knowledge observed in rural homes may indicate decreased cultural capital in rural areas. Thus, while research,

policies, and programs regarding early academic development have traditionally focused on urban children, this study suggests that the resources and information that buttress positive academic development should be specifically targeted to rural families in order to promote academic success for rural children. Since children in the U.S. are spread across the urban–rural continuum, it is exceedingly important to take urbanicity into account when developing policies aimed at improving the life chances of America's children.

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Appendix A. Periodicity of measures

	Wave 1 9 months	Wave 2 2 years	Wave 3 4 years	Wave 4|5 Kindergarten
Outcomes				
Reading skills				×
Math skills				×
Predictors				
Urbanicity	×	×	×	
Child characteristics				
Gender	×			
Race/ethnicity	×			
Low birth weight	×			
Health status	×	×	×	
Age at kindergarten assessment				×
Kindergarten cohort				×
BSF-R cognitive ability	×			
Parental characteristics				
Family income	×	×	×	
Parental education	×	×	×	
Maternal employment	×	×	×	
Marital status	×	×	×	
Maternal depression	×		×	
Household characteristics				
Number of children	×	×	×	
Region	×	×	×	
Immigrant household	×	×	×	
Non-English speaking household	×	×	×	
Mediators				
Home environment				
Parenting quality		×	×	
Stimulating materials/activities		×	×	
Child dev. knowledge	×			
School readiness beliefs			×	
Educational expectations			×	
Child care type	×	×	×	

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